Remarks

Claims 26 - 52 are pending. Favorable reconsideration is respectfully requested.

Claim 28 had been rejected under 35 U.S.C. § 112 ¶2. The language has been amended to specify that the hydrocarbon group is linked to Si by an Si-C bond, which is the only possibility, since hydrogen is monovalent in such situations. Si-C linked hydrocarbon groups are most common, these being the linking groups in compounds such as tetramethylsilane, tetraethylsilane, hexamethyldisilazane, etc. Applicants submit that the claim language is clear and solicit withdrawal of the rejection of claim 28 under 35 U.S.C. § 112 ¶2.

Claim 37 has been amended to recite that the metal catalyst is effective to accelerate cleavage of carbamates. It is believed that this claim is also clear to one skilled in the art, and withdrawal of the rejection of the claim under 35 U.S.C. § 112 ¶2 is solicited.

Claim 31 has been amended to correct a clerical error. The claim now correctly recites "O-organocarbamates" rather than "O-organocarbonates."

Claims 26 - 52 have been rejected under 35 U.S.C. § 103(a) over Okawa, U.S. Patent No. 5,166,414 ("*Okawa*") in view of Kober et al., U.S. Patent No. 3,366,662 ("*Kober*"), further in view of Faroj, U.S. Patent No. 5,686,675 ("*Faraj*"). Applicants respectfully traverse this rejection.

It is unclear as to why *Faraj* is cited. If it is cited to show, as indicated on page 4 of the Office Action, next to last paragraph, that the bis(N-formamide) of toluene diamine is a known compound, Applicants admit on the record that this is the case. Applicants believe that this compound has been known for many, many years. However, the process of *Faraj* has nothing in common with the present invention. *Faraj* teaches manufacturing isocyanate precursors which are unsymmetrical carbamates and ureas from formamides, dialkylamine, and alcohol, in the presence of a noble metal catalyst. This reaction has nothing in common with

that of the present invention. The drawbacks of using noble metal catalysts is discussed in the specification on pages 2 and 3.

Okawa discloses a process for manufacturing isocyanates in a two step reaction. In the first step, which requires catalysis by a basic catalyst, a formamide is reacted with dimethylcarbonate to produce the corresponding urethane compound. The urethane compound is then purified to be free of catalyst and thermolyzed in a high boiling solvent. Methanol and the isocyanate product are separated from the vapor phase.

As an "alternative" process, *Okawa* reacts an amine with methylformate in the presence of dimethylcarbonate and alkali catalyst, apparently generating the respective formamide *in situ*, which then reacts with dimethylcarbonate to produce the urethane. The urethane is then purified, and the catalyst-free urethane is thermolyzed in high boiling solvent.

Kober is a very old reference (1968) which discloses one of a myriad of failed, phosgene-free methods of isocyanate production. *Kober* reacts one of a select and limited group of organic amines with a diarylcarbonate and distills isocyanate from the reaction mixture. Yields of 55 - 68% are reported. The amines of *Kober* are limited to alkyl- and arylmonoamines and α,ω-alkylenediamines. Glaringly missing from this list are the amine precursors to the most important isocyanates of commerce: diaminodiphenylmethane, toluenediamine, and isophoronediamine. One assumes that the *Kober* process does not work with such compounds, in particular since *Kober* specifically mentions the large quantities in which toluene diisocyanate is produced, but fails to indicate that 2,4-toluenediamine could be employed in his process.

With respect to the diarylcarbonate used, *Kober* prefers diphenylcarbonate, but several halogenated arylcarbonates are also mentioned (column 2, lines 37 - 43). Noteworthy is the absence of <u>any</u> mention of <u>any</u> alkylcarbonate.

In the present invention, a diarylcarbonate or mixed aliphatic/arylcarbonate is reacted with a formamide precursor of the desired isocyanate, preferably in the absence of a

catalyst (claim 40), and pyrolyzed. A one step reaction, without isolation of intermediate O-carbamate is also preferred (claim 31).

The present invention is not disclosed, taught, or suggested by the cited references, either alone or in combination, within the requirements of 35 U.S.C. § 103(a). First, the references are not physically combinable. Second, there is no motivation to combine the references.

Okawa is directed to a specific isocyanate synthesis process employing a formamide isocyanate precursor and one very specific carbonate, dimethylcarbonate. When *Okawa* uses his alternative process involving an amine, he further employs methylformate, which reacts with the amine to produce the respective formamide *in situ*. In both processes, a byproduct is easily vaporizable methyl alcohol, in the preferred process being derived from the dimethylcarbonate, and in the alternative process, being derived both from the methyl formate as well as the dimethylcarbonate.

Okawa does not disclose any other carbonate as being useful in his process, although a myriad of organic carbonates have been known and commercially available for many years, and were certainly known to *Okawa*. One reason for this is clearly connected with *Okawa's* process, in which following purification and separation of catalyst, the O-methyl-carbamate (methyl urethane) product is pyrolyzed in high boiling solvent to generate a vapor of methanol and isocyanate, from which the latter is fractionally condensed. Higher alkyl and particularly aryl carbanates would not work in such a process, as the boiling points of the respective alcohols which would be liberated are too high to effect efficient separation.

However, there are chemical reasons why *Okawa* failed to consider organic carbonates as well. The stabilities of phenol-ester linkages and those of aliphatic alcohols are different. *Okawa* may have believed that other carbonates were too fast reacting, or too slow reacting, or would react differently or form undesirable byproducts. For whatever the reason, however, *Okawa* is very specific to dimethylcarbonate. This is his teaching. He suggests no other carbonate.

While *Okawa* indicates that "aromatic" formamides are useful in his process, the "aromatic" formamides he discloses are not truly aromatic, but rather are aliphatic formamides where the formamide group is separated from the aromatic ring system by an intervening alkylene group. An example is the bis(formamide) of xylylene diamine, where the formamide group is bonded to a methylene group which is then bonded to the benzene ring.

Applicants have tested the ability of dimethylcarbonate to react with aromatic substrates, such as the bis(formamide) of 2,4-toluene diamine. At 150°C, no reaction occurs if uncatalyzed. If catalyzed by basic catalysts such as 4-(N,N-dimethylamino)pyridine, a variety of N-methylated products are obtained; no dicarbamates are produced. With $NaOCH_3$ as the basic catalyst, again, N-methylated products are produced. A declaration pertaining to these results can be submitted if the Examiner so desires. Thus, the reason *Okawa* discloses any aliphatic formamides is that his reaction only appears to work with such aliphatic compounds.

Diametrically opposed to *Okawa* is *Kober*. *Kober* does not teach the reaction of formamides with dimethylcarbonate. Factually, *Kober* does not react or produce formamides. *Kober's* reactants are amines and diarylcarbonates. When *Kober* uses amine reactants, he does not use the required methylformate required by *Okawa*. Thus, the reaction of *Kober* is completely different from that of *Okawa*.

With respect to the organic carbonate employed by *Kober*, he is quite specific, preferring diphenylcarbonate, and disclosing only halogenated diarylcarbonates in addition to the preferred diphenylcarbonate. Thus, while *Okawa* requires dimethylcarbonate and fails to mention any other carbonates, *Kober* uses diarylcarbonates and fails to mention a single aliphatic carbonate. The respective teachings relating to the organic carbonate are diametrically opposed. The references cannot be physically combined for this reason. To simply take the diphenylcarbonate of *Kober* and substitute it for the dimethylcarbonate of *Okawa* would make the *Okawa* process unworkable. *Okawa* <u>requires</u> separating isocyanate product from a vapor stream of methanol and isocyanate, due to the low boiling point of methanol. If diphenylcarbonate were substituted for dimethylcarbonate, phenol, a much higher

boiling alcohol (about 120°C higher) would be liberated during the course of the reaction rather than methanol.

The reactions in *Okawa* and *Kober* are also very different. *Okawa* reacts a formamide, prepared separately, or *in situ*, with dimethyl carbonate. *Kober* does not do so. *Kober* reacts an amine with a diarylcarbonate. *Kober* does not employ any formamide. The starting materials of *Okawa* and *Kober* are completely different. In *Okawa*'s *in situ* process, the formamide is generated by reaction of an amine with methylformate. *Okawa* states that reaction of amine with methylformate is rapid, and thus it is the *in situ*-produced formamide, and not the amine which reacts with dimethylcarbonate. *See Okawa* at column 3, line 62 to column 4, line 9 and column 4, lines 29 - 41. Because the starting materials are chemically different, *Okawa* chose dimethylcarbonate as the sole organic carbonate in his process, while *Kober* chose a diarylcarbonate in his very different process. To combine these references would require picking and choosing only selected portions of the reference disclosure (i.e. diphenylcarbonate) while ignoring other salient features (such as *Kober's* different starting materials). To pick and choose in this manner is improper, and cannot be used to support a rejection under 35 U.S.C. § 103(a). *In re Wesslau*, 147 U.S.P.Q. 391 (CCPA 1965).

There is no motivation to combine these references. The Federal Circuit has recently addressed the quantum of evidence required to support an allegation of motivation to combine references.

In the case of *In re Anita Dembiczak* and *Benson Zinbarg*, 50 U.S.P.Q.2d 1614 (Fed. Cir. 1999), the CAFC has indicated that the requirement for showing the teaching or motivation to combine references is "rigorous." *Dembiczak* at 1617. Moreover, this showing, which is rigorously required, must be "clear and particular." *Dembiczak* at 1617. See also, *C.R. Bard v. M3 Sys., Inc.*, 48 U.S.P.Q.2d 1225, 1232 (Fed. Cir. 1998). It is well established that merely because references <u>can</u> be combined, the mere suitability for logical combination does <u>not</u> provide <u>motivation</u> for the combination. See, *Berghauser v. Dann, Comr. Pats.*, 204 U.S.P.Q. 398 (DCDC 1979); *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 221 U.S.P.Q. 929 (Fed. Cir. 1984). Moreover, mere conclusory statements

supporting the proposed combination, standing alone are not "evidence". *McElmurry v. Arkansas Power & Light Co.*, 27 U.S.P.Q.2d 1129, 1131 (Fed. Cir. 1993). *See also, In re Lee*, 61 U.S.P.Q. 2d 1430 (Fed. Cir. 2002).

Here, while the aim of both references is to provide a non-phosgene process for isocyanate production, there the similarity stops. *Okawa* discloses a specific process for preparation of isocyanates where the isocyanate is separated from a vapor phase of methanol/isocyanate. One skilled in the art would not be motivated to substitute a diarylcarbonate for the dimethylcarbonate of *Okawa*, since by so doing, the entire process disclosed by *Okawa* would be rendered inoperative. There would be no methanol/isocyanate vapor phase, nor any equivalent vapor phase containing an isocyanate and a low boiling solvent derived from an organic carbonate. One would further not be motivated to make this substitution since neither reference suggests doing so. Factually, since the respective reactions are <u>different</u>, and because each reference is directed only to a specific class of organic carbonates with no <u>mention</u> of any organic carbonates of the other class, there is a complete lack of any evidence of motivation to combine, much less any evidence which rises to the clear and particular standard required by Dembiczak.

It is respectfully submitted in view of the discussion above, that the claims are non-obvious over the combination of *Okawa, Kober* (and *Faraj*). Withdrawal of the rejection of the claims under 35 U.S.C. § 103(a) is solicited.

However, certain of the claims are further distinguished from the references. Claim 30, for example, requires the formamide to be the formamide of 2,5-toluenediamine. Note that 2,4-toluenediamine is an amine which is not taught as useful in *Kober's* process (*Kober* is not directed to formamides, however). The bis(formamide) of toluenediamine is not suggested by *Okawa*, and in fact, use of this compound with *Okawa's* dimethylcarbonate leads only to N-methylated products, not O-carbamate isocyanate precursors.

Claim 37 requires a metal catalyst in the carbamate cleaving step. *Okawa* teaches that metal catalysts cannot be used in this step.

Claim 40 requires no catalyst to be present during any part of the process. *Okawa* requires a basic catalyst in his first step.

Claim 45 requires a continuous process wherein organoformate is recycled to the reaction mixture. The Office states this limitation to be obvious, but has supplied no reference in support of such a conclusion; nor is such a process suggested by any reference, whether alone or in combination.

Claim 46 requires thermolysis to take place without isolating the O-carbamate intermediate. *Okawa* requires isolating the O-carbamate and separately thermolysing.

No reference or any combination teaches or suggests the detailed limitations of claim 50.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, he is highly encouraged to telephone Applicants' attorney at the number given below.

Respectfully submitted,

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Attachment

VERSION WITH MARKINGS TO SHOW CHANGES MADE

28. (Amended) The process of claim 27, wherein R comprises an optionally substituted C_{1-20} alkyl, C_{2-20} alkenyl, C_{2-20} alkynyl, C_{4-20} cycloalkyl, C_{4-20} cycloalkenyl, C_{6-30} aryl, C_{7-30} aralkyl, C_{7-30} alkaryl group, a silane or siloxane or oligomer thereof wherein formamide group(s) are bound to an [Si-bound hydrocarbon linking group] SiC-bonded hydrocarbon group, and wherein each of the above R may contain one or more chain or ring heteroatoms.

31. (Amended) The process of claim 26, wherein steps a) and b) are combined such that the reaction temperature of step a) is maintained at a temperature wherein isocyanate is produced directly without prior isolation of [O-organocarbonate] O-organocarbamate from said reaction mixture.

37. (Amended) The process of claim 27, wherein R is aliphatic or cycloaliphatic, said process further comprising adding to said reaction mixture [an effective carbamide-cleaving amount of] a metal catalyst which is effective to accelerate cleavage of carbamates produced by said process.